TWO NEW CLASSIFICATION TECHNIQUES USED BY

ONTARIO DEPARTMENT OF HIGHWAYS

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P.E. Wade, R.B. Truemner, and R.I. Wolfe

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INTRODUCTION

Ontario is a large province, extending approximately 1,000 miles in both the east-west and the north-south directions. By geology and climate it is divided into two distinct parts, which are disproportionate in area and economic development (Figure 1). In the cold northern part

Figure 1

lies the vast Precambrian Shield, an ancient rock formation on which are located most of Ontario's forestry and mineral resources and recreational areas. Southern Ontario contains 88 percent of Ontario's 5,300,000 people living in only 7 percent of the area. Within the Southern area virtually all of Ontario's agricultural and industrial activity is carried out. These two areas have different transportation needs and the techniques described below were put to greater use in the highly developed southern portion.

The highways of Ontario are classified into three major jurisdictions:

1. The King's Highway System under the control of the Province.

2. The County Road System under the control of the organized Counties.

3. The Township Road System under the control of the organized Townships.
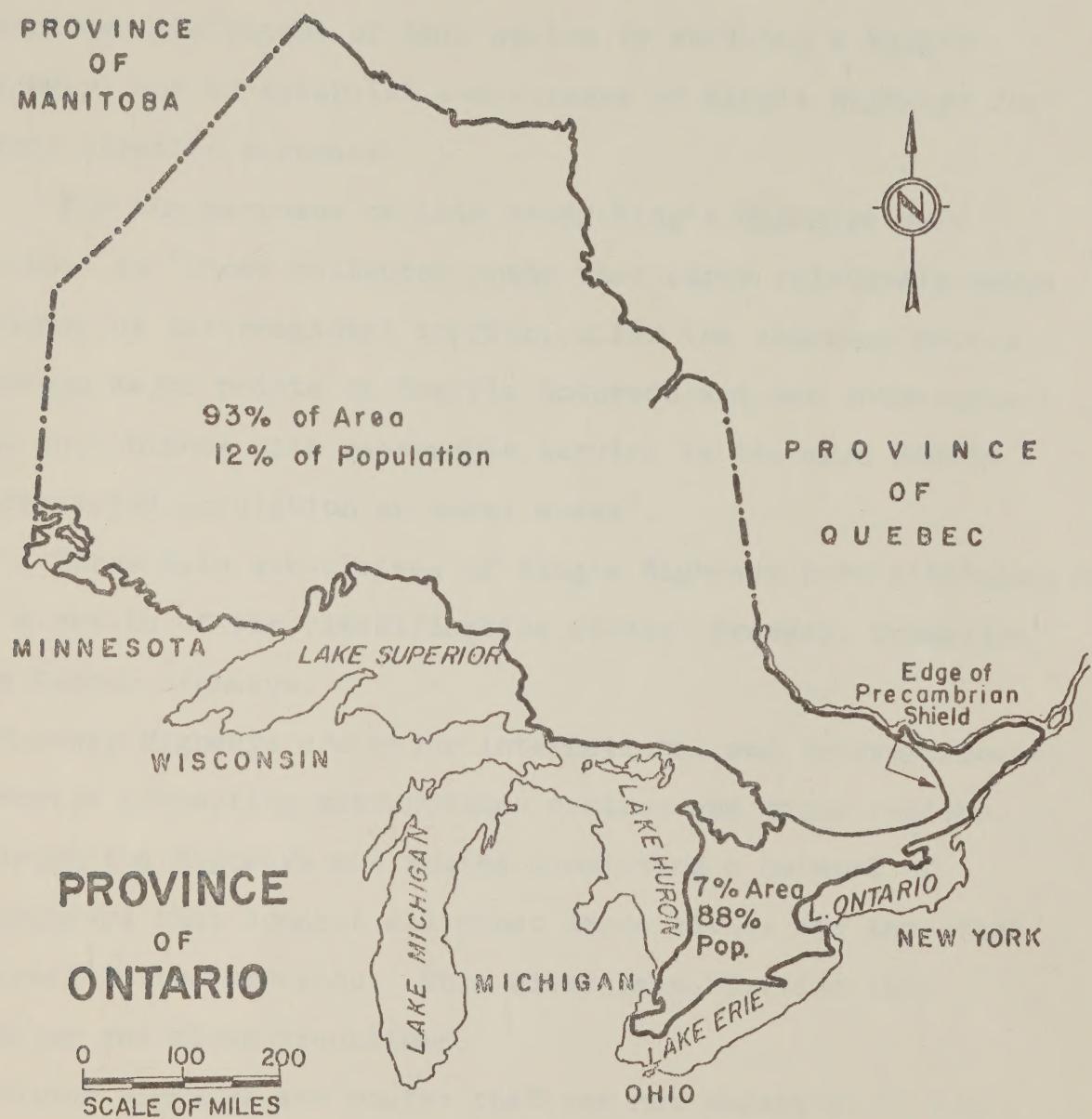
PROVINCE
OF
MANITOBA

93% of Area
12% of Population

PROVINCE
OF
QUEBEC

MINNESOTA   LAKE SUPERIOR

Edge of
Precambrian
Shield

WISCONSIN

LAKE MICHIGAN

LAKE HURON

7% Area
88%
Pop.

L. ONTARIO

NEW YORK

PROVINCE
OF
ONTARIO

MICHIGAN

LAKE ERIE

OHIO

0   100   200
SCALE OF MILES

Townships.

It was the purpose of a recent study conducted by the Department of Highways of Ontario to classify the King's Highway System in conjunction with a comprehensive needs study of these roads. This classification had two objectives: to stabilize the extent of this system by defining a King's Highway: and to establish sub-classes of King's Highways for administrative purposes.

For the purposes of this study King's Highways were defined as "Those collector roads that carry relatively large volumes of interregional traffic, offer the shortest routes between major points of traffic interest and can interconnect all such places with reasonable service to the more widely distributed population in rural areas".

Three main sub-classes of King's Highways were established as a result of the classification study: Freeway, Trunkline and Feeder highways.

* Freeway Highways are major international and interprovincial routes connecting metropolitan centres and major regions.

* Trunkline Highways are routes completing a network of highways that connect all other large cities and important areas in the province. This class is subdivided into Major and Minor Trunklines.

* Feeder Highways are routes that are not essential to the interconnection of the system but that maintain a desirable and consistent level of service to all areas of the province.

For the purpose of defining the limits of the system and to differentiate the sub-classes, criteria were sought as a measure of the service characteristics of each highway

section. These include the familiar elements: traffic volume,
population of urban centres, natural resources and land use
characteristics, plus the integration of the highway network.

To indicate more precisely the function of each highway,
two added measures of service were developed: Intercentre
Service and Rural Access Service.

INTERCENTRE SERVICE

A major service performed by a Provincial or State
highway system is the interconnection of important popu-
lation centres. The place a highway is given in an overall
classification depends to a large extent on the total
intercentre service it thus provides, irrespective of any
other considerations.

Accordingly some method was sought for defining and
evaluating this aspect of highway service. The results of
Origin-and-Destination surveys were utilized for this purpose.
These determine the amount of traffic wishing to travel
between various population centres. A measure of highway
Intercentre Service was obtained by relating this data to
the different classes of population centres.

Place Classification

Of the various characteristics indicating the importance
of population centres, it was decided that population was the
most significant, particularly from a traffic generation
consideration. Therefore cities and towns in Ontario were
classified by total population. A curve was drawn of the
populations of the centres in diminishing order of size.(Figure
Figure 2 no L
2). A guide in the selection of classes was the shape of this
curve.

PLACE CLASSIFICATION
SOUTHERN ONTARIO
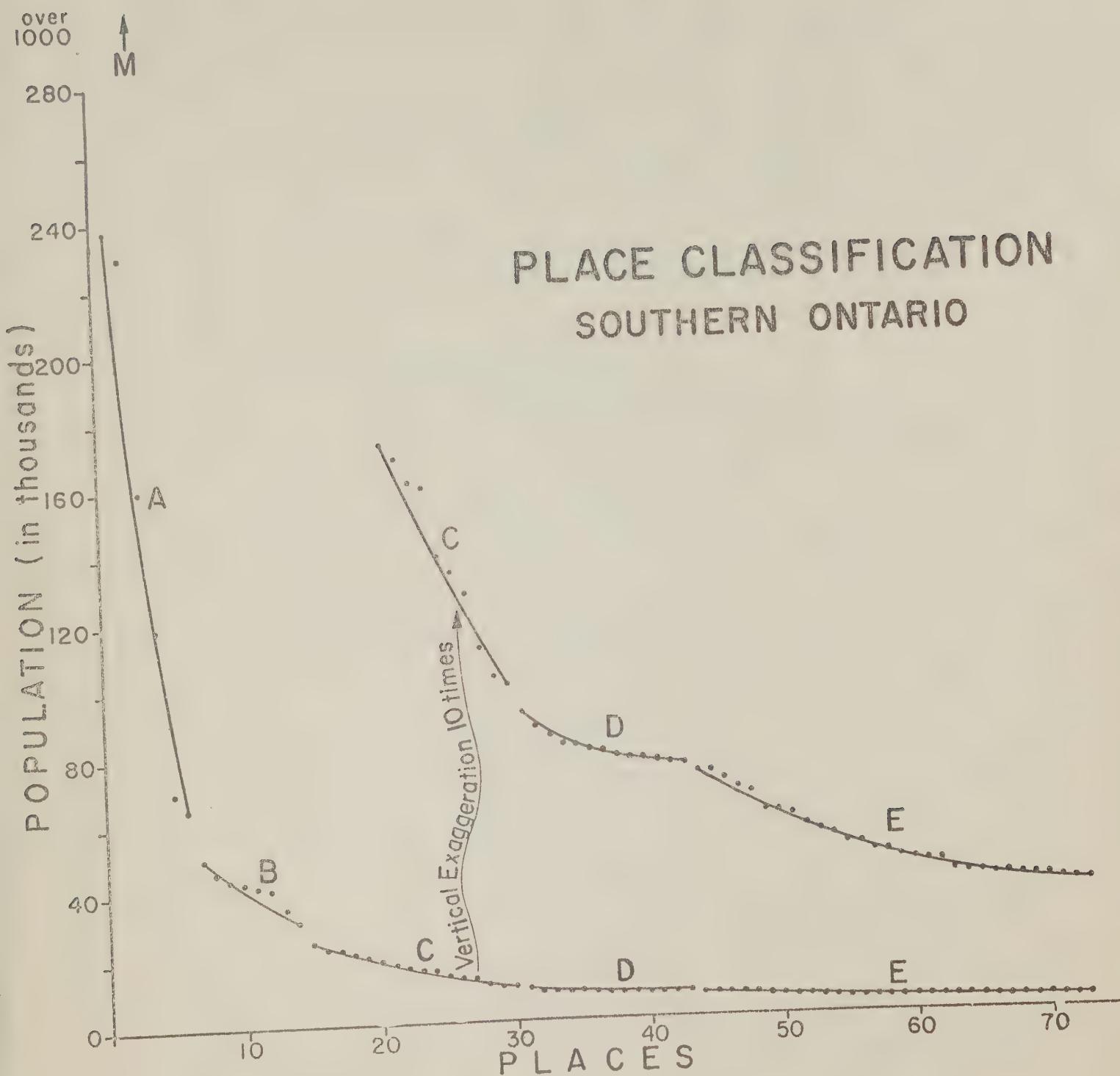
Class limits were chosen at well-defined breaks in the curve

slope. Six classes of population centres were selected and

the members of each class were assumed to be of the same

order of importance. For convenience, the classes were

identified by the letters M (metropolitan), A, B, C, D and

E. Population ranges were chosen for these place classes of

southern Ontario and are shown in Table 1. Border-crossing

Table 1-

towns were given a higher classification than their population

warranted, since a great deal of international traffic must

funnel through them.

Use of Origin-and-Destination Data

External Origin-and-Destination surveys have been made

at most of the major centres in the Province. The numbers of

daily through trips between all surveyed centres of over

3,500 population. (the minimum size of places classified),

were tabulated from these O-D data, and the average number

of daily through trips was computed for each type of place

connection. M to M connections, for example, averaged 660

daily trips, M to A connections 620, and so on.

It was found that average numbers of daily through trips

Table 2-

approximated either 600, 300 or 100 for most intercentre

connectors (Table 2). These approximate averages were used

to construct a convenient point system, in which a conversion

factor of one point was assigned to each 100 daily through

trips. Accordingly, the various types of intercentre

connectors were assigned either 6, 3 or 1 points with little

distortion of the end results.

TABLE I

CLASS	POPULATION RANGE	
M.......over		1,000,000
A.......60,000 to	300,000
B.......30,000 to	60,000
C.......10,000 to	30,000
D....... 7,500 to	10,000
E....... 3,500 to	7,500

TABLE 2

CONVERSION OF INTERCENTRE TRIPS

TO POINT RATINGS

INTERCENTRE CONNECTOR	AVERAGE DAILY THROUGH TRIPS Year: 1954	POINT RATING
M to M	660)	
M to A	620)	6
M to B	610)	
A to A	360)	
M to C	340)	3
A to B	310)	
A to C	280)	
A to D	160)	
M to E	120)	
M to D	110)	1
B to C	100)	
Others	100∠)	

Assignment of Point Ratings to Highway Sections

The determination of the total number of combinations of intercentre connectors for each highway section was carried out graphically. All connectors between the various classes of centres were geographically located on separate transparent overlays and in different widths of line (Figure

Figure 3-
3). By placing these transparent overlays upon a map of existing highways, the intercentre connectors served by each highway section were determined and a total point rating was computed, by assigning either six, three, or one points for each connector (Figure 4).

Figure 4-
Where the distance between two centres was so great that any travel desire between them would be insignificant, then their connector was excluded. This usually was done when the number of daily trips for a given connector fell below 20 percent of the average for that type of connector. This was established by referring to the available O.D. data and using judgment when this data was incomplete.

Application to Classification

Finally, these results were related to the highway classification. Ranges of point ratings for each highway

Table 5-
class were selected, containing most highway sections in the class (Table 3). Each route falling outside of the range of intercentre point ratings for its class was studied further for assignment to another class.

In this way a numerical intercentre point rating was established and utilized as a separate factor in the functional classification of the King's Highway System.

FIGURE 3

INTERCENTRE CONNECTORS

INTERCENTRE POINT RATINGS
SOUTHERN ONTARIO
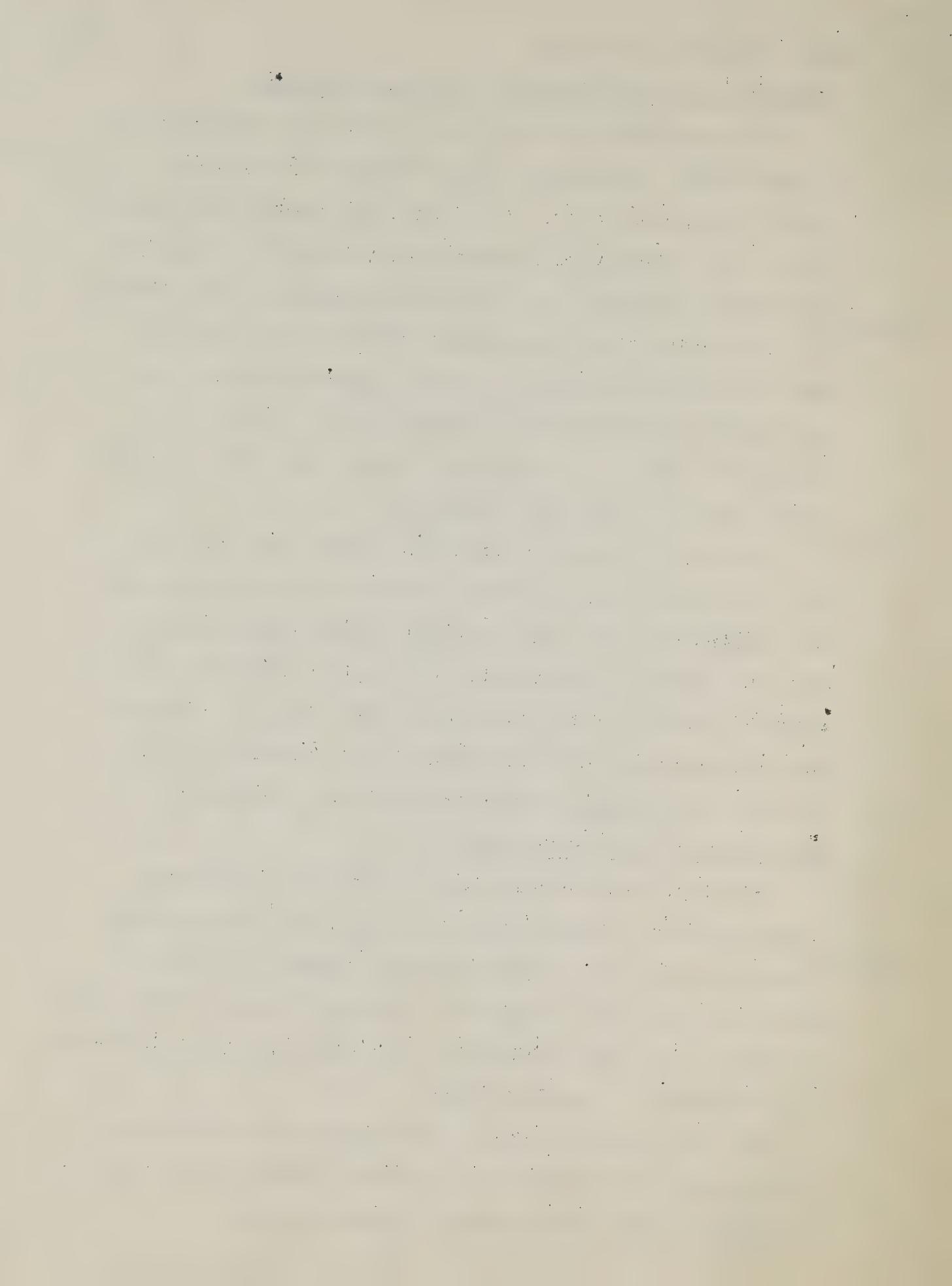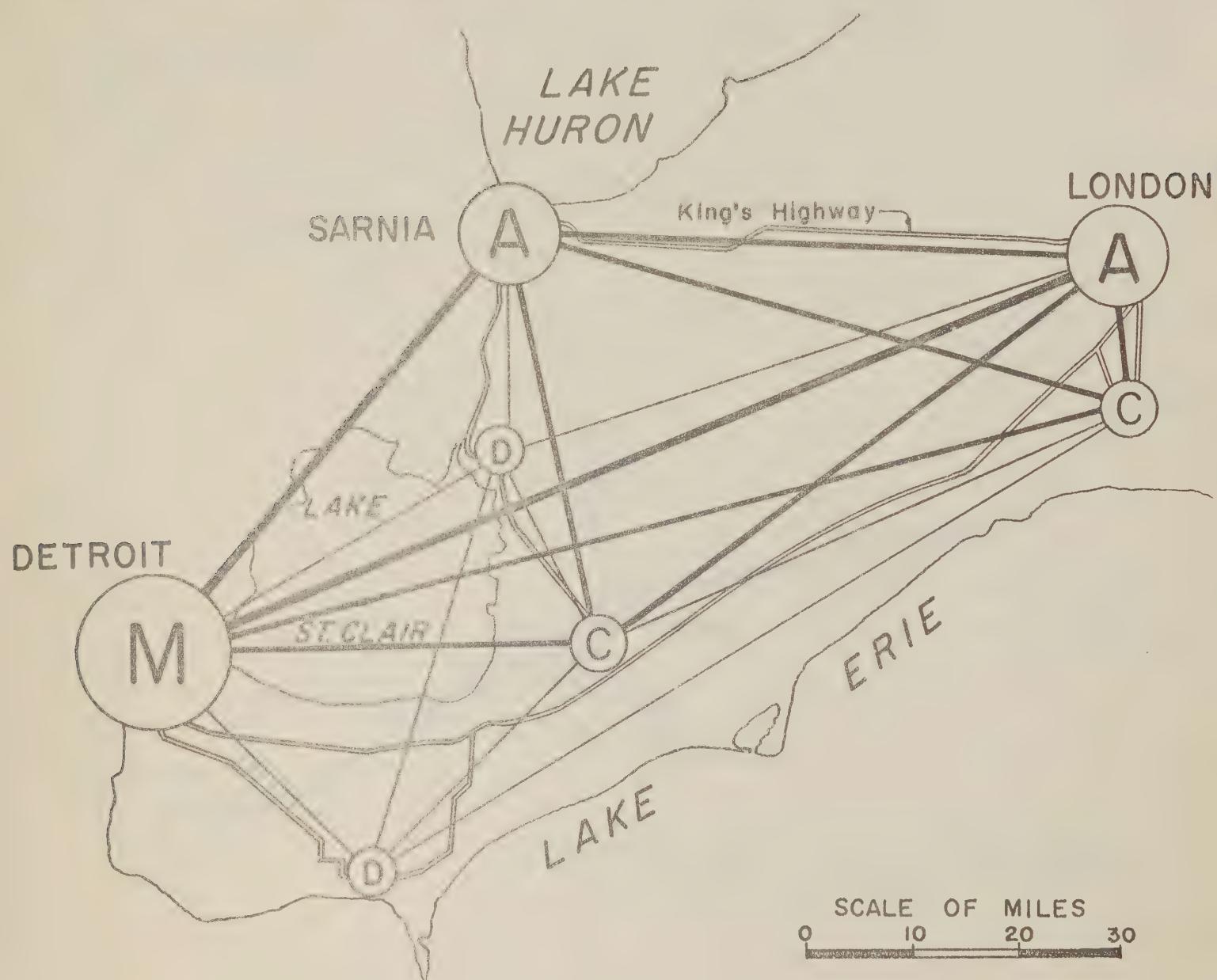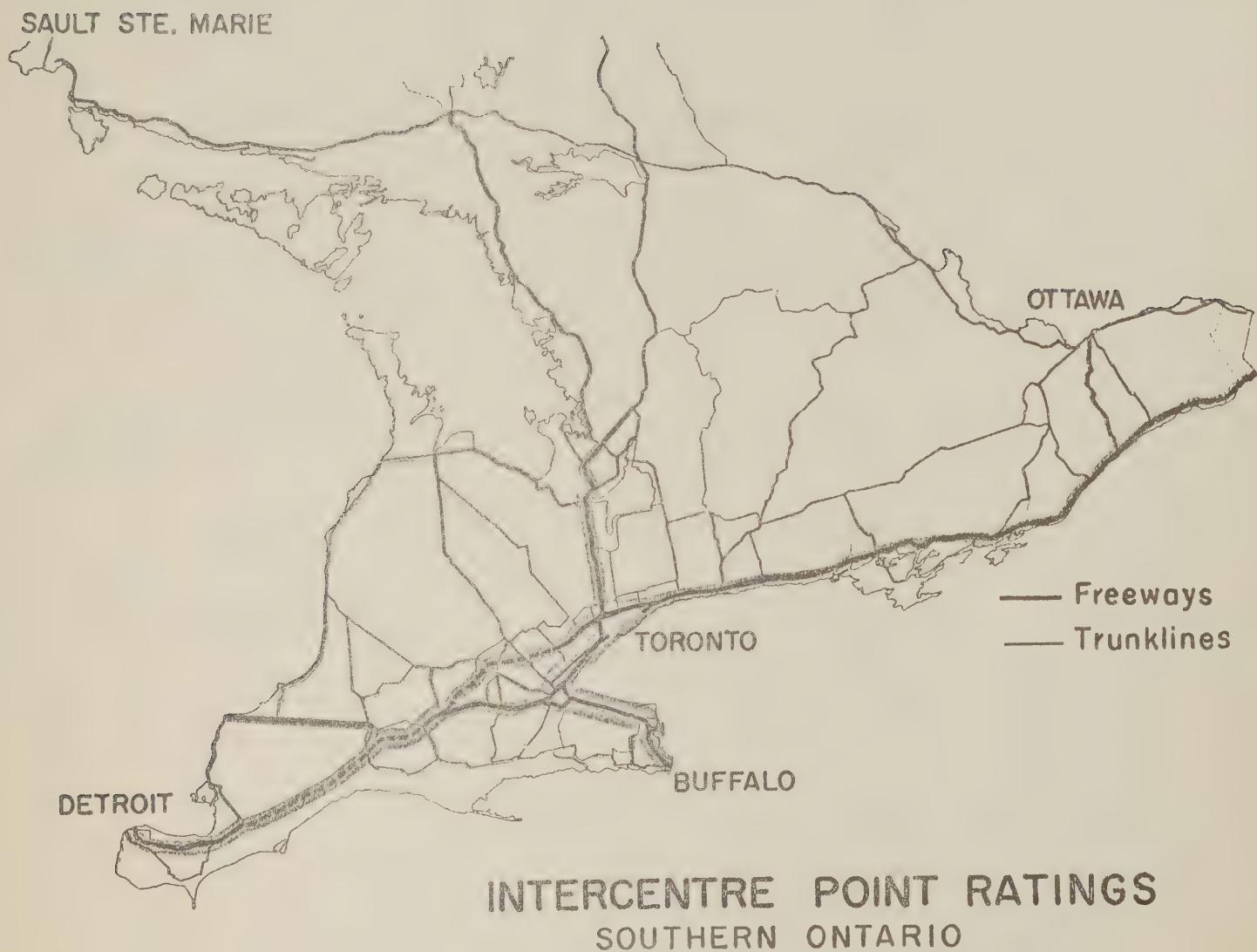
TABLE 3

	HIGHWAY CLASS	INTERCENTRE POINT RATING		
		Average		Range
Southern Ontario	Freeway	35		over 20
	Trunkline	4		
	Major		8	6 to 20
	Minor		3	1 to 5
Northern Ontario	Trunkline	3		
	Major		4	over 3
	Minor		3	1 to 3
All of Ontario	Freeway	35		over 20
	Trunkline	4		
	Major		5	4 to 20
	Minor		3	1 to 5

RURAL ACCESS SERVICE

Besides providing connections between population
centres, provincial highways also serve rural populations.
To be adequate a system of King's Highways must give persons
living in rural areas the opportunity to travel beyond their
own localities on conveniently located routes.

The existing King's Highway System was found to be
generally satisfactory in this respect. The objective
therefore was to establish, with a minimum of changes, a
highway system providing consistent service. Accordingly
the following principle was adhered to: that the inhabitants
of any rural area should have a King's Highway as close as
have the inhabitants of other rural areas with similar
development.

To study this characteristic the accessibility of King's
Highways was related to the density of rural population in
the following manner.

Rural Population

The objective was to establish minimum qualifications
for King's Highways in agricultural regions where uniformity
of population density exists. The chief criterion selected
to indicate the economic development in these areas was the
density of rural population. To compute population densities
published data for the townships of Ontario were used. (Not
included were populations in centres of 1,000 or over, or
in suburban areas).

By inspection five ranges of population density were
Table 4-
established (Table 4).

TABLE 4

CLASS	POPULATION DENSITY per square mile
Very High	over 50
High	35 to 49
Average	25 to 34
Low	10 to 24
Very Low	under 10

Regions with very low population densities, that is, with fewer than 10 persons per square mile, were excluded from further study. These sparsely settled rural areas contain little agricultural development, and other considerations, for example recreational land use, have greater importance in the evaluation of highway service.

Highway Cells

The network of King's Highways creates what may be called "highway cells", areas completely bounded either by highways alone or by highways and shorelines. Within each cell there may be any number of municipal roads, but no other King's Highways. This "highway cell" was used as the unit of rural area (Figure 5).

Figure 5-

The chief measure of highway accessibility was taken as the distance in miles from the most remote point within each highway cell to the bounding highways. At the same time the effects were taken into account of such factors as the pattern of the internal network of municipal roads within each cell, and the locations of the nearest major market centres or traffic generators.

Finally, a useful tool in the classification process was prepared by plotting for each highway cell the most remote distance value against the population density. This may be referred to as the accessibility scatter diagram (Figure 6).

Figure 6-

Application to Classification

The accessibility scatter diagram was useful in establishing minimum qualifications for King's Highways in agricultural areas; that is, for setting the limits for Feeder Highways in these areas. It was utilized as a guide when making

FIGURE 5

RURAL ACCESS SERVICE

LAKE

HURON

14 miles
20 persons/sq.mi.

6 mi.
22

7 mi.
21

6 mi.
27

8 mi.
18

5 mi.
25

SCALE OF MILES
0   5   10
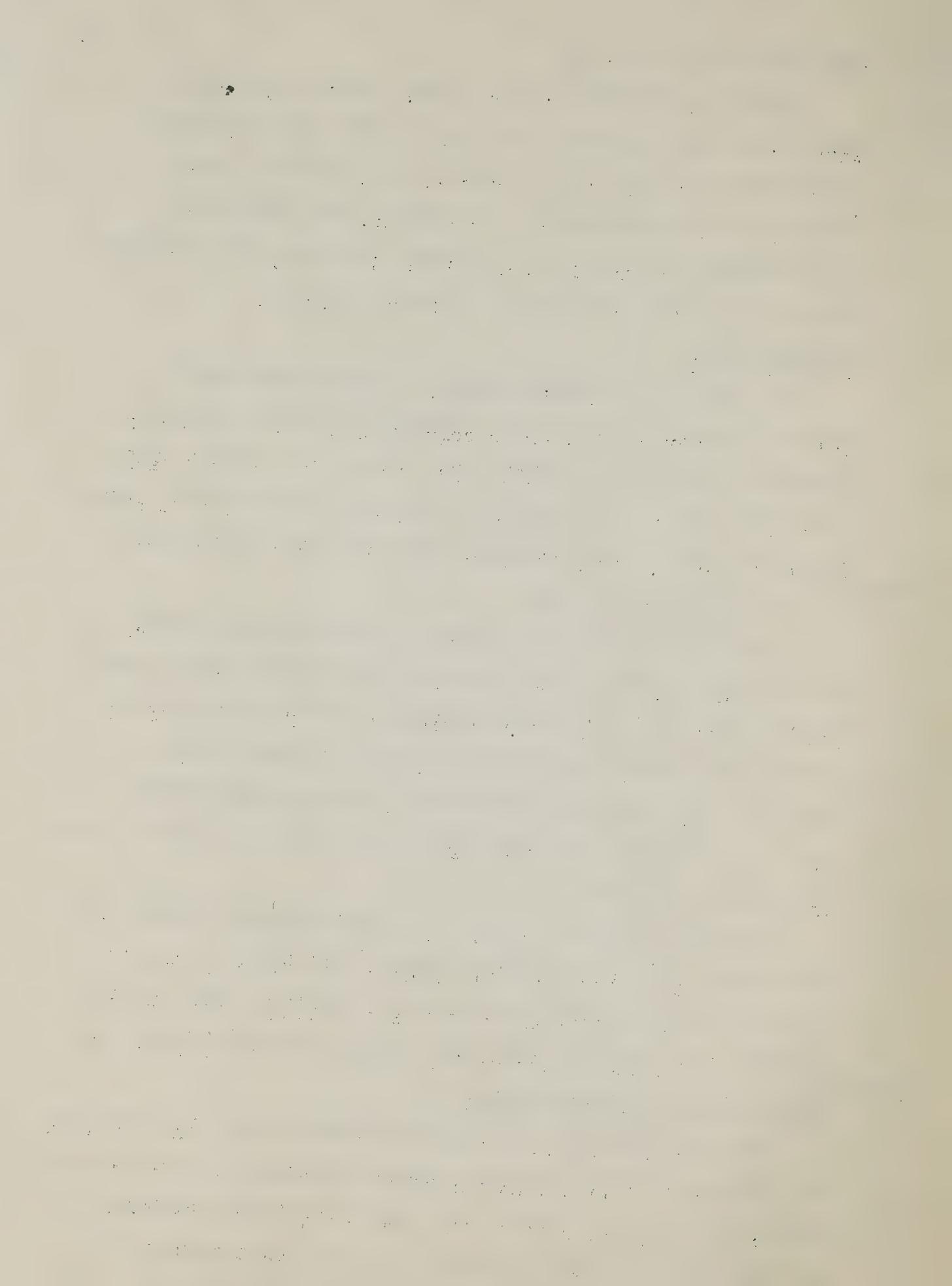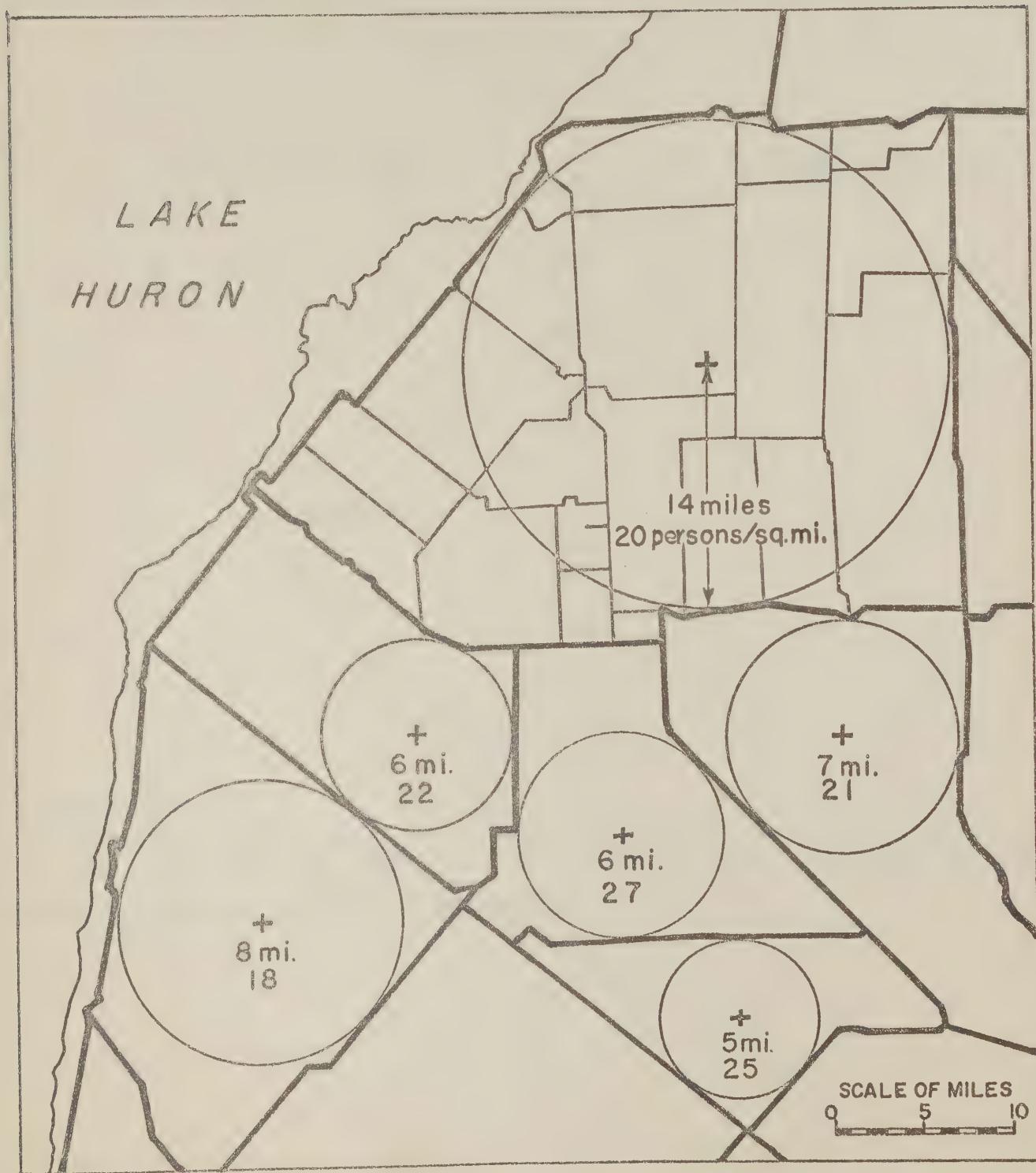
RELATION OF
HIGHWAY ACCESSIBILITY TO POPULATION DENSITY
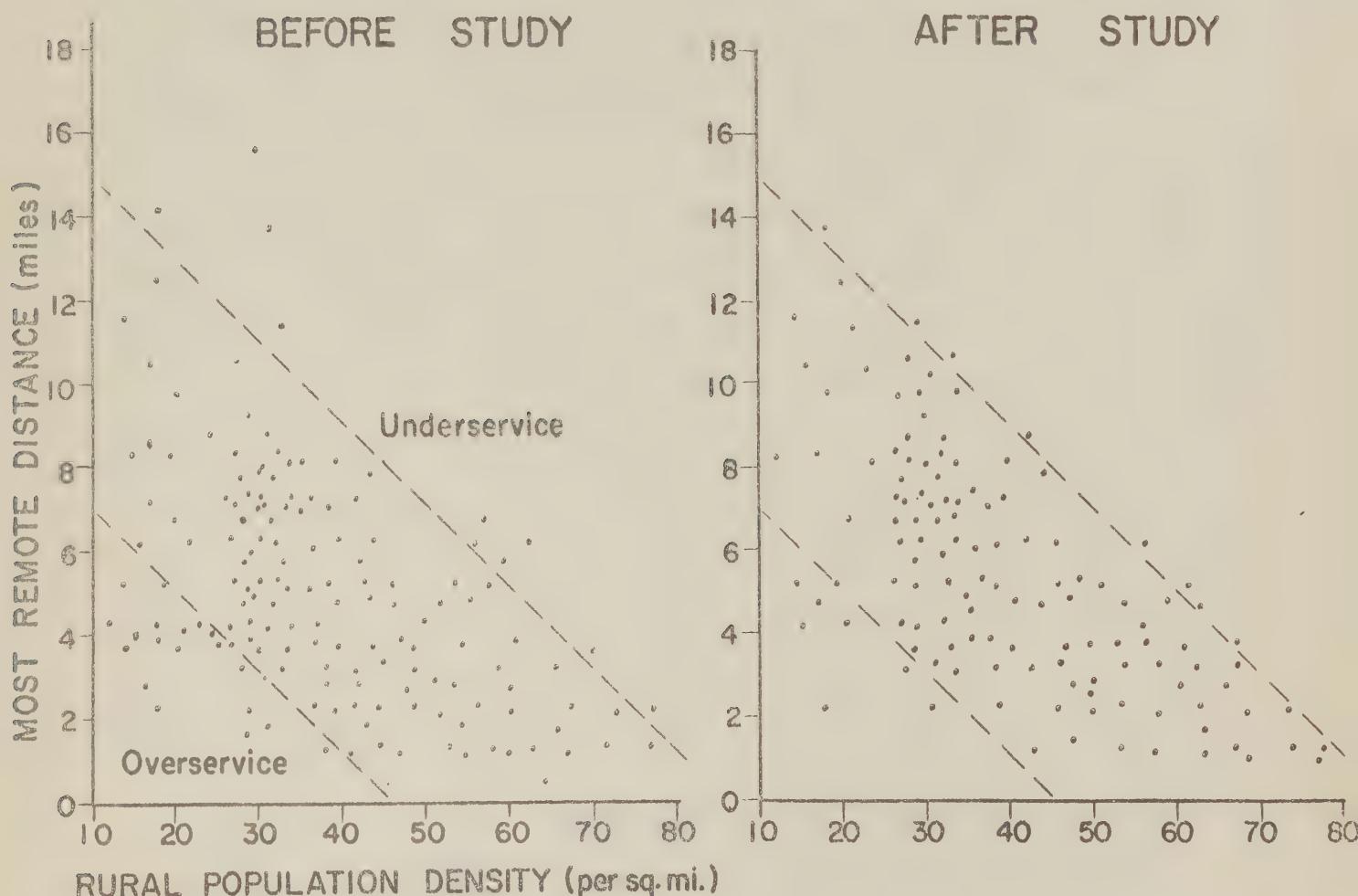
decisions concerning areas either overserviced or underserviced
by King's Highways.

Overserviced areas

In the route-by-route analysis of the King's Highway
System, when a particular highway rated relatively low for the
usual service characteristics, such as traffic volume,
intercentre service or otherwise, the scatter diagram was
referred to. The accessibility of the adjoining areas was
considered in relation to that of other areas of similar
population density. If the accessibility distances indicated
that the adjoining areas were overserviced, that is the
accessibility distances were considerably shorter than for
most similar areas, then the road was considered seriously
for reversion or transfer to another system. If, on the
other hand, removal of the route would cause the adjoining
areas to have relatively large accessibility distances or
become "underserviced", then a strong argument existed for
retaining the highway on the system.

Underserviced areas

To identify areas of relatively poor accessibility it
was necessary to examine the scatter diagram and select the
areas that had distances considerably larger than those for
areas of similar population density. When these had been
identified, each was studied in more detail and possible
routes were considered for assumption in the highway system.
When all factors pointed to the establishing of consistent
service if one or more routes were assumed, then such
assumptions were recommended.
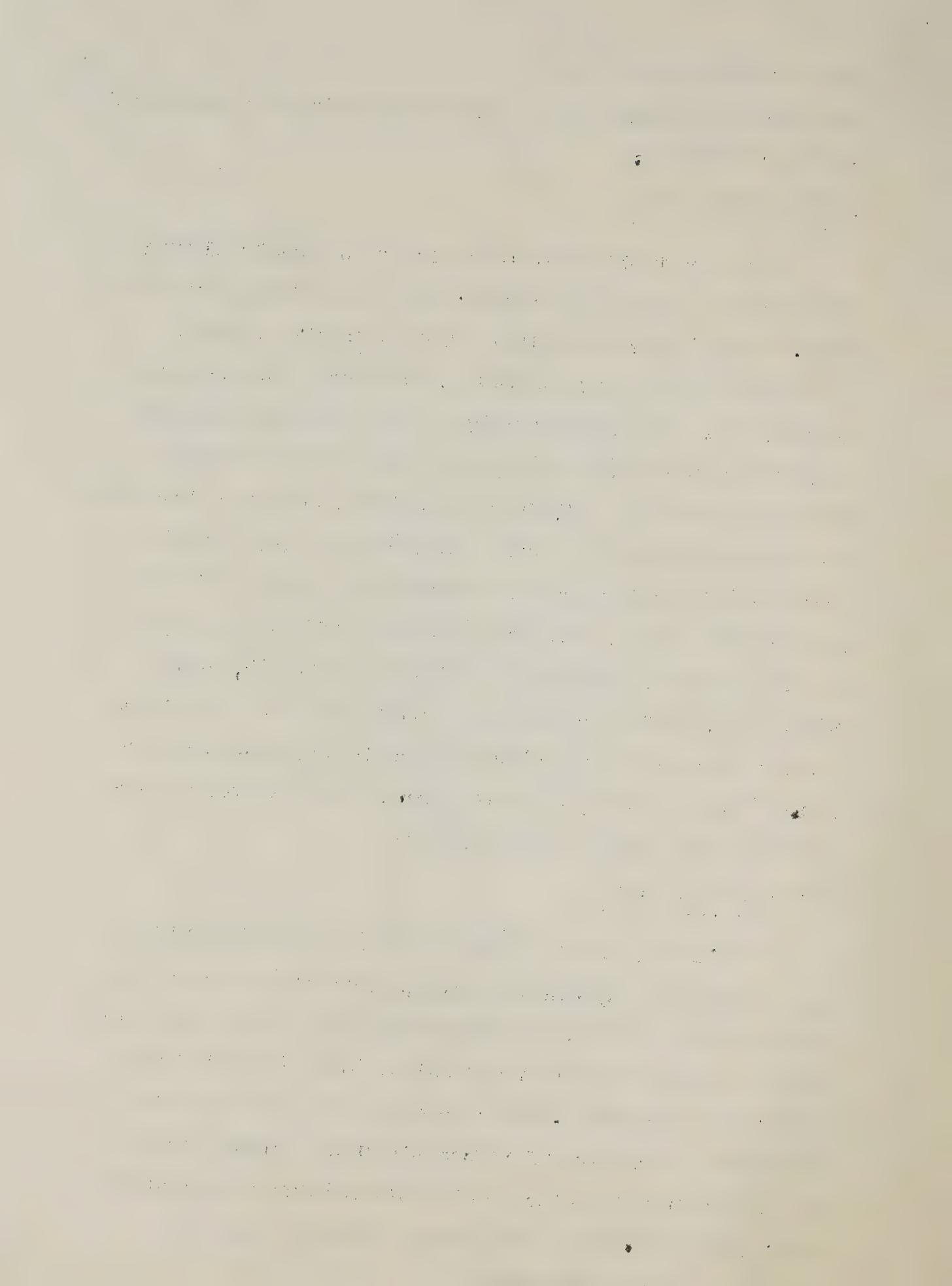
An important consideration was the desirability of keeping

all changes to a minimum. Where a suggested change made

similar changes necessary in other areas, then it was avoided

if possible.

It was apparent that the ranges of remote distances

varied by population density. That is, the lower the

population density, the greater were the distances to the

nearest highways. Upon inspection of prevailing service

conditions in Ontario a series of ranges of prevailing

remote distances for the different population density

classes were selected (Table 5).

Table 5-

Since factors other than rural land access strongly

affect the location of King's Highways, such ranges were not

analyzed statistically nor rigidly adhered to, and served

only as a guide. However, comparison of the scatter diagrams

for conditions before and after the study was completed

show how a greater consistency of service was obtained for

the areas having large remote distances. Those areas having

small remote distances do not display the same conformity.

This is expected since in many cases the highways in these

areas must be retained for valid service reasons.

FINAL CLASSIFICATION

With the aid of the above simple quantitative guides

and of service criteria previously mentioned, a final King's

Highway Classification was established (Table 6).

Table 6-
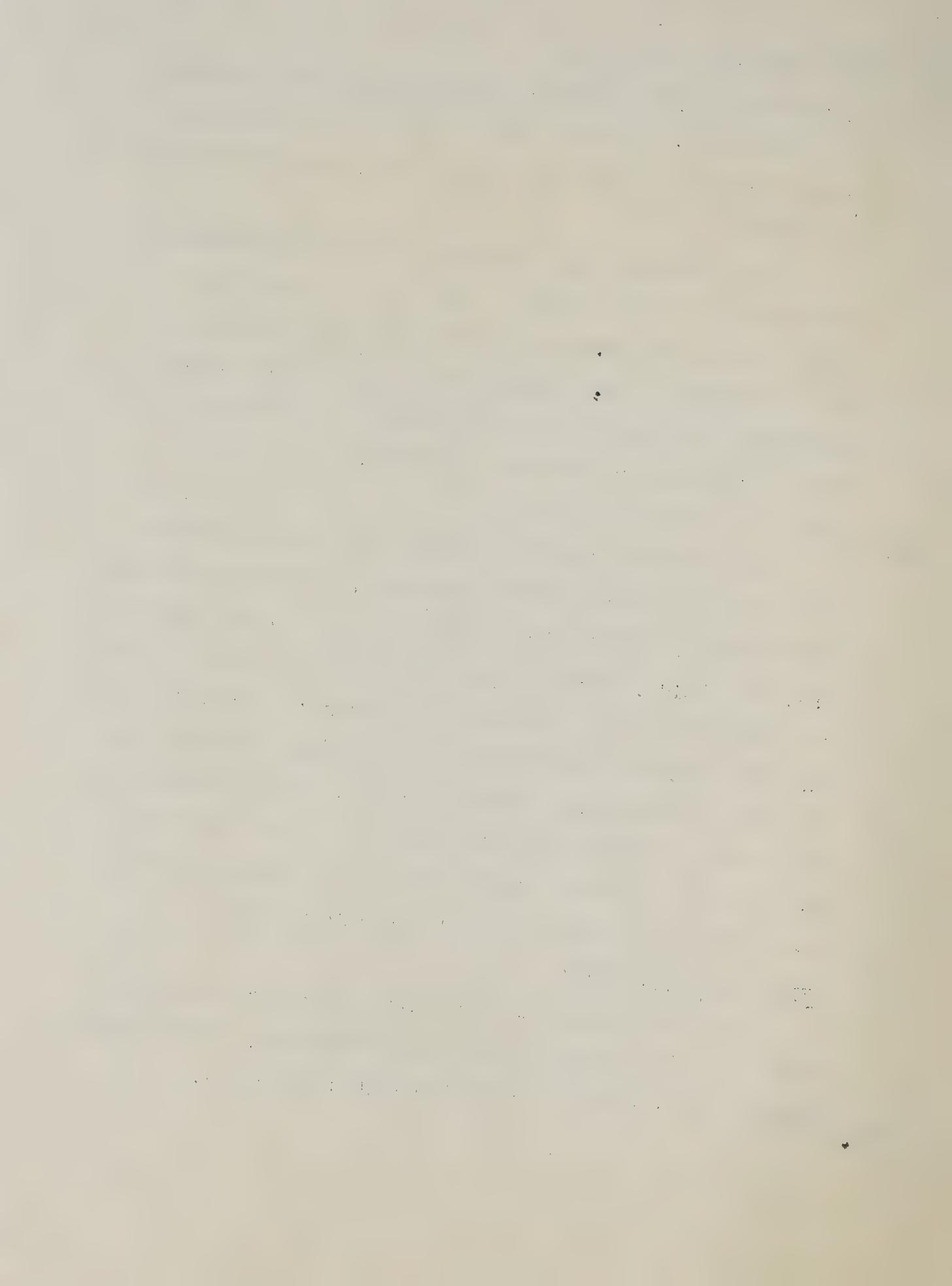
TABLE 5

| CLASS	POPULATION DENSITY per square mile	RANGE OF REMOTE DISTANCES in miles
Very high	over 50	under 5
High	35 to 49	4 to 7
Average	25 to 34	5 to 9
Low	10 to 24	7 to 11
Very Low	under 10	over 10

TABLE 6

HIGHWAY CLASS.	MILES	%	TRAFFIC VOLUME*	INTERCENTRE POINT RAT'G.	TRAVEL %
Southern Ontario					
Freeway	820	17	6100	35	39
Trunkline	2230	46	2500	4	43
Major	(600)	(12)	(3800)	(8)	(18)
Minor	(1630)	(34)	(2000)	(3)	(25)
Feeder	1790	37	1200	–	18
Northern Ontario					
Trunkline	2790	72	700	3	80
Major	(1470)	(38)	(800)	(4)	(48)
Minor	(1320)	(34)	(600)	(3)	(32)
Feeder	1080	28	450	–	20
All of Ontario					
Freeway	820	9	6100	35	32
Trunkline	5010	58	1500	4	50
Major	(2060)	(24)	(1670)	(5)	(23)
Minor	(2950)	(34)	(1370)	(3)	(27)
Feeder	2870	33	900	–	18
	8700				

*1954 average daily traffic